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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

August 20 - August 26, 1999

Summary 99-34

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EVENTS

1. PROPELLED DRUM LID INJURES RESEARCH ASSISTANT

On August 13, 1999, at the Savannah River Technology Center, an engineer participating in a research project received a laceration to the forehead when he was struck by a lid propelled from a pressurized drum. He and a technician were pumping approximately 30 gallons of sludge from an experimental tank to a nearby 55-gallon drum, using a positive displacement pump, when he noticed that the flow had stopped. Workers had installed a valve and pipe on the side of the drum near the bottom for the sludge transfer. They left the lid on the drum to eliminate splashing during the transfer. The engineer shut the pump off and determined that the pump had pressurized the drum to 15-20 psig. The lid propelled from the drum as he attempted to release pressure by loosening the locking ring. Figure 1-1 shows the experimental equipment and the final resting place of the lid. The sludge had a pH of approximately 5 and contained traces of mercury. Responders transported the injured employee to the site medical facility, then to a local hospital, and from there to a plastic surgeon who closed the wound. This event is significant because the sudden release of pressure from pressurized drums can cause severe personal injury, expose personnel to contamination, or release hazardous or toxic contents to the environment. (ORPS Report SR--WSRC-LTA-1999-0030)

Figure 1-1. Drum and Propelled Lid

Facility personnel immediately isolated the slurry pumping system and barricaded the general area. The facility manager stopped work on the system and held a critique of the occurrence. The following are Integrated Safety Management System and conduct-of-operations concerns that investigators identified.

- Both a hazards screening checklist and an experimental safety checklist failed to include the sludge transfer as part of the work scope. Hazard screeners had emphasized chemical and environmental hazards associated with the planned research activities but did not include hazards associated with pumping sludge at the completion of the research.

- Workers did not comply with procedural requirements for transfers and did not stop to fully analyze hazards associated with a process change. They had removed the drum lid during a previous transfer, but decided to leave the lid in place during the current transfer to minimize splashing hazards.

- Workers did not comply with safety requirements. The engineer did not stop work when he identified an abnormal condition. Additionally, he might have avoided injury if he had worn a face shield as required by work procedures.

- Workers were distracted by multiple tasks. After they started the transfer pump, they became involved in relocating drums, weighing drums, and labeling samples. Investigators believe that workers may also have felt a sense of urgency to meet customer milestones.

- Communications between individuals involved in the evolution were poor. It was not clear who was responsible for the sludge transfer. A technician connected the transfer pump and tubing, but the engineer started the pump. It was not evident that either individual adequately monitored the transfer.

- Initial reactions to the event were neither adequate nor timely. The injured individual went immediately to the lavatory to inspect and clean the wound himself. Neither worker telephoned the emergency notification number, and no one notified control room personnel until approximately 45 minutes after the occurrence.

To prevent similar occurrences, facility managers plan to (1) review and revise the job hazard analysis and procedures for the experimental process and drum handling, (2) evaluate the need for task-specific briefings, (3) issue a lessons learned bulletin on this occurrence and issue a safety bulletin to research personnel, and (4) establish policy guidance to endorse willingness to stop work.

OEAF engineers reviewed an occurrence earlier this year that dramatizes the effects of even very low pressures in sealed drums. Weekly Summary 99-08 reported that shipping/receiving employees at the Los Alamos National Laboratory Plutonium and Processing Facility were opening empty 55-gallon drums when the lid of a drum forcibly ejected. The employees had noticed slight pressurization in other drums when they heard air escape as they opened them. An employee opening the drum assumed it was depressurized after hearing two releases of air from it. When he started to remove the retaining ring, residual pressure in the drum ejected the lid with enough force to propel it vertically about eight feet. Bags of vermiculite packaging material in the drum were also ejected. The empty drums had been sealed and shipped from Oak Ridge (elevation approximately sea level) to Los Alamos (elevation 7,200 feet). The change in altitude caused the pressure in the drum to increase by approximately 3 psi. (ORPS Report ALO-LA-LANL-TA55-1999-0006)

The injury at Savannah River underscores the importance of thoroughly analyzing hazards and following established work control programs without exception. Personnel at DOE facilities should have a continually questioning attitude toward safety issues. Each individual is ultimately responsible for complying with rules to ensure personal safety. Facility managers should communicate the idea that safety is of prime importance and that all personnel must be committed to excellence and professionalism. Worker training should emphasize that a change in work methods or equipment, or any other deviation from work instructions, can introduce unforeseen hazards. Any change to work instructions or methods should entail a work stoppage and a review of the potential hazards associated with the change. Workers should also be trained to stop work and report as-found conditions that are inconsistent with expected conditions.

This occurrence also underscores the importance of knowing the hazards that a pressurized drum presents to workers and the environment. Trained personnel should use procedures and equipment specifically developed for the safe venting of drums. Whenever possible, drum selection should take into account the possibility of pressurization and should incorporate a self-venting feature or provide for convenient manual venting. DOE/NS-0013, Safety Notice 93-01, *Fire, Explosion, and High-Pressure Hazards Associated with Waste Drums and Containers*, describes lessons learned on safe storage and handling of waste containers and drums. The

notice specifically discusses handling, storing, venting, and opening containers suspected of being pressurized or containing flammable vapors.

KEYWORDS: conduct of operations, injury, lid, pressurized drum, work control, work planning

FUNCTIONAL AREAS: Conduct of Operations, Work Planning

2. WELD FAILURES CAUSE DRILLING RIG TO FALL

On August 21, 1999, at the Pantex Plant, a drilling rig fell when welds that attach hydraulic lifting cylinders to the rig failed. The welds failed as the drill rig operator erected the rig, and the rig fell back into its cradle, crushing a hydraulic oil tank. The rig was approximately 25 feet in the air and approximately at a 60-degree angle when it fell. A sub-tier subcontractor owned and operated the rig, which was being used to drill environmental monitoring wells northeast of the plant site. Environmental restoration personnel stopped all further drilling work pending an investigation of the incident. On August 18, a drill operator assessed the rig and identified several stressed welds. A welder came to the plant site to repair the welds, but he determined the work was too extensive to do in the field. The subcontractor's district manager decided that the rig could be used even though the welds were stressed. A preliminary investigation revealed that the welds that failed were those previously identified by the subcontractor's personnel as being stressed. Safety personnel inspected another drill rig operated by the same subcontractor and found no welds with stress fractures. OEAF engineers will follow the investigation and will provide additional information, as it becomes available. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0059)

KEYWORDS: defective, fall, drill, personnel error, subcontractor, weld, well

FUNCTIONAL AREAS: Industrial Safety

3. PLUTONIUM STORAGE CANS DAMAGED

On August 12, 1999, at the Rocky Flats Environmental Technology Site, a facility manager reported damage to four plutonium storage cans that had been repackaged approximately seven weeks earlier. Each storage can consisted of two individual cans, stacked one inside the other, with the innermost can surrounded by plastic bags. Technical support personnel determined that the innermost cans contained plutonium, but they are unsure of its configuration. Based on the condition of the cans, technical support personnel are investigating whether the cans became dented during handling operations. Improper handling of plutonium can damage required packaging barriers and could result in material release. (ORPS Report RFO--KHLL-PUFAB-1999-0056)

Investigators determined that approximately seven weeks ago operations personnel repackaged several plutonium buttons and prepared them for shipment to Los Alamos National Laboratory for further disposition. Because the shipment was full, four of the cans could not be shipped, so operations personnel stored them in accordance with procedures. Investigators determined that the site plutonium transfer and storage procedure required operators to re-open the four remaining cans after 30 days of storage, brush any oxide off the buttons, and repackage them for long-term storage. Operators completed the repackaging operation on about August 5. Investigators determined that when operations personnel opened the outermost cans, they saw the damaged inner cans and noticed that the lids were partially lifted upward (approximately one-quarter of an inch). They reported the condition and notified Los Alamos personnel to inspect the shipment for additional damaged cans. Figures 3-1 and 3-2 show the damaged cans.

Figure 3-1. Damaged Can – Bottom View

Figure 3-2. Damaged Can – Inside View

The facility manager directed technical support personnel to investigate further. They will re-open the repackaged material cans to determine what configuration the plutonium is in and will examine similar packaged items. They will also conduct a repackaging/handling experiment to attempt to reproduce the damage. Los Alamos personnel will determine if any of the cans they received from the Rocky Flats Technology Site exhibit the same type of damage. The facility manger will develop corrective actions when technical support personnel have completed their investigation.

NFS has reported numerous plutonium events in the Weekly Summary. Following are some examples.

- Weekly Summary 97-48 reported that facility managers at the Hanford Site Plutonium Finishing Plant determined that an unreviewed safety question existed after they reviewed a photograph of an unexpected reaction that occurred when operators opened a plutonium storage can. Investigators believe the event was caused by air reacting with plutonium hydride inside the can. Based on the photograph and technical reviews, technical support personnel determined that a pressure excursion, large enough to blow out a glovebox window, could have occurred when the storage cans were opened. (ORPS Report RL--PHMC-PFP-1997-0027)

- Weekly Summary 94-09 reported that a vessel containing plutonium metal released plutonium oxide at Los Alamos National Laboratory. The incident resulted from the rupture of an inner storage vessel caused by mechanical forces from expansion due to plutonium oxidation. (ORPS Report ALO-LA-LANL-TA55-1993-0039; DP Safety Information Letter 93-05)

- Weekly Summary 94-08 reported that an operator at the Savannah River Site discovered a bulging lid on a sealed 40-ounce plutonium oxide storage can. Investigators later discovered six other slightly deformed cans containing stabilized plutonium oxide blended with other stable oxides. (ORPS Report SR--WSRC-FBLINE-1994-0010)

Many containers of plutonium are stored at Rocky Flats. The Defense Nuclear Facilities Safety Board recommended that Rocky Flats repackage the plutonium in accordance with DOE-STD-3013-94, *Criteria for Packaging of Plutonium Metals and Oxides for Long-Term Storage*, to eliminate existing hazards. They stated in Recommendation 94-1 that “additional delays in stabilizing these materials will be accompanied by further deterioration of safety and unnecessary increased risks to workers and the public.”

These events illustrate the need for a questioning attitude when unexpected conditions are observed. Lack of a questioning attitude can lead to unidentified and unassessed hazards that could result in loss of confinement, personnel or facility contamination, or personnel injury.

Operations supervisors and managers should ensure that operators exhibit a questioning attitude and do not become complacent with routine operations.

Facility managers should review the following documents to ensure that practices and procedures are properly implemented and provided for in the facility authorization bases.

- DOE O 5480.23, *Nuclear Safety Analysis Reports*, requires hazard analysis to ensure comprehensive, integrated, and balanced risk management of all safety and environmental hazards. Section 3 requires analyses of expected releases, exposures, and accidents. It also requires consideration of residual risks to ensure that the risks and consequences of operation are acceptable and to ensure conformance with safety design objectives.

- DOE Safety Information Letter 93-05, "Potential Worker Contamination from Failed Plutonium Storage Containers," describes safety problems associated with plutonium storage containers. The letter includes detailed information on plutonium oxidation processes in containment vessels that do not have certified hermetic seals.

- DOE-STD-3013-96, *Criteria for Preparing and Packaging Plutonium Metals and Oxides for Long-Term Storage,* provides a summary of packaging and storage criteria for plutonium metals. It states that plutonium materials must be in stable forms and packaged in containers designed to maintain their integrity under normal storage conditions and during anticipated handling accidents.

- DOE-HDBK-1081-94, *Primer on Spontaneous Heating and Pyrophoricity*, provides information on plutonium properties, including metal, oxides, oxidation, hydrides, and pyrophoricity. It also discusses plutonium storage and handling requirements.

A copy of the handbook can be found at http://www.doe.gov/html/techstds/standard/standard.html. Safety Notice 93-1 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the OEAF Home Page at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: plutonium storage, unreviewed safety question

FUNCTIONAL AREAS: Nuclear/Criticality Safety, Licensing/Compliance, Materials Handling/Storage

4. CONSTRUCTION EVENTS CAUSE PROJECT STAND-DOWN

This week, OEAF engineers reviewed a rollup report from Los Alamos National Laboratory. The facility manager for the Firing Sites and High Explosive Laboratory initiated the report identifying three construction events at a natural gas line replacement project that resulted from inadequate planning and execution by Johnson Control Northern New Mexico (JCNNM) and caused a project stand-down. In the first event, a construction crew struck and severed a potable water line with a backhoe, releasing 30,000 gallons of water to the environment. The crew had not followed the hand-digging procedure used to locate underground utilities. In the second event, construction workers were pulling three anchors for a high-voltage pole out of the ground with a backhoe when the last anchor pulled up and severed an existing gas line, causing a release of natural gas. Again, hand digging was not performed. In the third event, a dump truck snagged and pulled down two overhead communication lines because the driver operated the truck without a spotter. Although these events did not result in personnel injury, construction accidents

have caused equipment damage, loss of vital services, injury, and death. (ORPS Report ALO-LA-LANL-FIRNGHELAB-1999-0004)

On August 11, a JCNNM construction crew was attempting to locate utilities for a natural gas line project that involved the replacement of 19,000 lineal feet of 2-inch gas line with a 4-inch gas line. Procedures required hand digging within three feet of buried utilities. The construction crew was attempting to locate a sewer line by digging manually (potholing), but mud was getting back into the pothole. Although they were not to use heavy equipment, a backhoe operator tried to help remove the mud. The backhoe struck and severed a 6-inch potable water line. Isolation of the water leak was delayed for several reasons. First, it took 2.5 hours to get an on-call pipe fitter to the site. When he arrived, the pipe fitter did not know where the shutoff valve was located. Finally, once the pipe fitter found the valve box he had to clear it of mud before the valve could be closed. Investigators determined that a JCNNM procedure clearly states: "If the excavation will be within three (3) feet of a utility locate mark, hand excavate until the marked utility has been found and exposed." However, the construction crew did not follow the procedure.

On August 17, as part of the same project, JCNNM laborers were tasked to pull three anchors out of the ground with a backhoe to make room for the new gas line. The anchors supported an out-of-service, high-voltage pole. While pulling the last anchor, they severed a gas line, causing a gas release. The backhoe operator immediately shut the equipment down and exited the vehicle. Laborers stopped traffic in the area, initiated roadblocks, and called for emergency response. Emergency personnel isolated the gas line. Investigators determined that the third anchor was located within two feet of the gas line, thus requiring hand digging to access it. The laborers did not realize that the anchors were bent at an angle, which made them susceptible to snagging. This event resulted in a 1-day stand-down to re-evaluate the safety aspects of the job, walk-down the site, and re-evaluate any potential unforeseen hazards. Work restarted on August 18.

On August 19, a dump truck operator was dumping sand at the project to bed the ditches for the new gas line. As the operator drove from the area, the truck bed snagged and broke two communications lines, even though the operator knew the overhead lines were there. An unwritten JCNNM policy requires the use of a spotter with these operations, but no spotter was assigned to assist the dump truck operator. Investigators determined that the truck driver was lowering the truck bed when the lines became trapped. While driving away, he felt a tug and stopped the truck. He got out, looked around, and saw nothing that would cause the tug. He began to leave the area again, felt the tug again, and got out and looked a second time. He still saw nothing. At this point, he lowered the bed completely and continued driving away, breaking the lines.

A division manager ordered a stand-down of the project until corrective actions can be implemented and the hazards mitigated. JCNNM is developing a restart plan. Corrective actions and the Integrated Safety Management five-step process will be included in the restart plan. A project activity hazard analysis is under review, and a laboratory-wide review of similar type events is underway.

NFS has reported many construction-related events in the Weekly Summary. Some examples follow.

- Weekly Summary 99-21 reported that a subcontractor backhoe operator punctured a buried 6-inch, 55-psi natural gas line while excavating to install a drainpipe for an electrical vault at the Federal Energy Technology Center. The subcontractor failed to follow procedures that required him to locate the pipeline, mark its location before digging, and use hand tools to locate the pipeline. (ORPS Report HQ--GOPE-FETC-1999-0004)

- Weekly Summary 99-16 reported that the raised bed of a dump truck driven by a subcontractor struck and severely damaged overhead conductors across a

roadway at Argonne National Laboratory—East. The conductors consisted of 120- and 480-volt lines and communication cables. Investigators determined that a spotter assigned to the project had been involved in other activities at the time of the occurrence. The driver told investigators that he didn't realize that the truck bed was up. (ORPS Report CH-AA-ANLE-ANLEAPS-1999-0003)

- Weekly Summary 99-10 reported that a construction subcontractor operating a trackhoe at the National Renewable Energy Laboratory struck and ruptured a 2-inch natural gas distribution line. Investigators determined that he failed to follow a project manager's instructions ragarding the excavation boundaries and was working in an area that should have been excavated by hand. (ORPS Report CH-NA-NREL-NREL-1999-0001)

These events underscore the need to follow procedures that govern construction activities such as excavation and heavy equipment operation. Adequate project planning and execution is important for worker safety. As part of planning for work around buried utilities, a good practice is to ensure that isolation boundaries are identified and accessible to knowledgeable personnel in the unlikely event that a utility is breached. The time required for isolation is important, not only to prevent the loss of water or gas, but also to prevent environmental damage from water erosion or the potential of explosion or fire from gas. The existence of buried utilities can be determined with appropriate combination of radar, magnetic, and sonic detectors, and the exact location can be determined by hand digging. The following references provide additional guidance about excavation safety.

- OSHA 29 CFR 1926, *Safety and Health Regulations for Construction,* subparts .651(b) and .651(a)(3), make employers responsible for identifying underground hazards near a work area. 29 CFR 1926.965(c) requires work to be conducted in a manner to avoid damage to underground facilities and protection to the workers. Additional information on excavation is available from OSHA at http://www.osha-slc.gov/SLTC/trenchingexcavation/index.html.

- DOE/EH-0541, Safety Notice 96-06, *Underground Utilities Detection and Excavation,* provides additional descriptions of excavation events. The notice describes technology for underground utility detection, specific recommendations for improving excavating programs, and innovative practices used at DOE facilities. The notice states that a central coordinator should not only assist in identifying underground utilities but should also record the findings. The safety notice cites other principal causes of excavation and digging occurrences as failure to use hand digging because of the pressure of schedules, and failure to detect underground utilities because detection devices were not used or were used ineffectively. The safety notice is available at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: construction, excavation, gas line, industrial safety, overhead, potable water, truck, utility, work planning

FUNCTIONAL AREAS: Construction, Industrial Safety, Work Planning

5. WORKERS EXPOSED TO LEAD ABOVE PERMISSIBLE EXPOSURE LIMIT

On August 19, 1999, at the Los Alamos National Laboratory, industrial hygienists at the Pajarito Laboratory determined that two Radiation Control Technicians (RCTs) received exposures to airborne lead exceeding the OSHA permissible exposure limit of 50 micrograms per cubic meter averaged over eight hours. Between August 11 and August 13, six RCTs removed approximately 1,300 lead bricks from a storage shed and stacked them outside the shed as part of a clean-up task that also involved labeling the bricks and checking them for radioactive

contamination. Individual exposures for RCTs who worked inside the shed, passing bricks to their counterparts outside the shed, were 50 micrograms per cubic meter on August 11; 87 and 97 micrograms per cubic meter on August 12; and 36 micrograms per cubic meter on August 13, normalized to an 8-hour work shift. (ORPS Report ALO-LA-LANL-TA18-1999-0012)

The facility manager held a critique to determine the facts surrounding the exposures. Critique participants learned that the general hazard control plan and work authorization for resumption of activities following an August 1998 stand-down did not contain precautions specific to airborne lead exposure. Because of a concern about handling a large number of lead bricks inside a closed environment, work planners developed a procedure to augment the work authorization. This procedure, which was reviewed by industrial hygienists, required representative breathing zone air samplers for each work station and one for the general area inside the shed. All RCTs involved in the lead-handling task wore leather gloves, light coveralls, steel-toed safety shoes, and safety glasses. The RCTs who worked inside the shed also wore protective skullcaps to minimize dust accumulation. The augmented work procedure did not require respiratory protection for any of the workers. Critique participants learned that the lead bricks in the storage shed were considerably dusty and a few were lightly corroded. They also learned that the RCTs had not rotated through the work station inside the storage shed as frequently as industrial hygienists had specified.

Industrial hygienists ordered blood tests for the two RCTs who worked inside the shed and offered the other four RCTs the opportunity for voluntary blood tests.

Facility personnel have developed the following corrective actions for this occurrence.

- Certify a high-efficiency particulate air-filtered vacuum cleaner for use in final cleanup of the lead storage shed.
- Vacuum the lead bricks before returning them to the storage shed.
- Investigate the feasibility of coating lead bricks for general use to minimize oxidation and lead dust production.
- Specify damp-cleaning wherever feasible.
- Require at least a half-face, air-purifying respirator for all future bulk lead handling tasks.

The ORPS database contains numerous occurrences of inadvertent overexposures to hazardous substances that were caused, in part, by underestimating the amount of airborne contaminants that tasks are capable of generating. The following are some examples.

- Industrial hygienists at the Savannah River Technology Center determined that an employee relocating lead bricks may have been exposed to airborne lead above the OSHA permissible exposure limit on May 7, 1998. The employee could have been exposed to 43 micrograms per cubic meter over a 10-hour work shift. The permissible exposure limit under these conditions is 40 micrograms per cubic meter. Control measures applied to the task had not included respiratory protection. The bricks involved were known to be at least 15 years old with significant surface corrosion. (ORPS Report SR--WSRC-LTA-1999-0029 and Weekly Summary 99-33)
- Two workers at the Idaho Waste Experimental Reduction Facility were exposed to airborne cadmium dust at levels that exceeded the protection factor for their respiratory protection equipment. The workers were cleaning and inspecting an incinerator off-gas heat exchanger. Although facility operators had encountered elevated levels of cadmium dust in the heat exchanger during past cleanings,

engineers did not expect the very high levels encountered during this task. (ORPS Report ID--LITC-WERF-1998-0007 and Weekly Summary 98-42)

- At the Kirtland Office Inhalation Toxicology Research Institute, a field technician was exposed to airborne respirable lead slightly above the permissible exposure limit while he was wiping lead shielding to remove dust and oxidation. Investigators determined that work planners had not fully evaluated oxides of lead or the effects of lead cleaning and sweeping activities. Facility supervisors revised work procedures to require respiratory protection until they could validate the effects of additional engineering controls. (ORPS Report ALO-KO-ITRI-LOVELACE-1995-0003)

- Two technicians at the Lawrence Livermore National Laboratory moved approximately 450 lead bricks without wearing respiratory protection and were exposed to greater than the OSHA permissible exposure limit for lead. Industrial hygienists had not expected airborne lead levels to reach the permissible exposure limit. Investigators determined that lead oxide dust disturbed during brick handling had become airborne. (ORPS Report SAN--LLNL-LLNL-1992-0041)

These events underscore the importance of applying conservative assumptions to hazard analyses for tasks that involve the handling of hazardous substances or basing the analyses on proven exposure data. The following paragraphs summarize some of the requirements of the OSHA standards for exposure to lead. OSHA maintains equivalent standards for monitoring and controlling exposures to cadmium, beryllium, asbestos, and other hazardous substances.

- 29 CFR 1926.62, *Lead*, paragraph (d)(2), "Protection of employees during assessment of exposures," states: . . .where lead is present, until the employer performs an employee exposure assessment and documents that the employee is not exposed above the permissible exposure limit, the employer shall treat the employee as if the employee were exposed above the permissible exposure limit and shall implement employee protective measures . . ." These measures, described in paragraph (d)(2)(v), include respiratory protection. Paragraph (d)(2) also lists the tasks requiring interim worker protection and provides data to guide the selection of appropriate respiratory protection. The intent of interim protection is to ensure that employees are not unduly exposed during exposure assessments. Paragraph (d)(3), "Basis of initial determination," relieves the employer of performing an initial monitoring program if reliable data from a prior monitoring program is available. However, current work processes, type of material, control methods, work practices, and environmental conditions must closely resemble those previously monitored and documented.

- 29 CFR 1910.1025, *Lead*, describes the employer's responsibilities for the protection of employees from ingestion or inhalation of lead in general industry. The standard states that employers shall determine whether any employee is exposed to lead at or above the action level. Initial determinations may be based on monitoring results combined with (1) information, observations, or calculations that would indicate employee exposure to lead, (2) any previous measurements of airborne lead, or (3) employee complaints of symptoms that would indicate exposure to lead. This standard is less specific than 29 CFR 1926.62 regarding the application of previous measurements to initial determinations and provides no guidance for interim protective measures. However, paragraph (c)(1) states without qualification that the employer shall assure that no employee is exposed to lead at concentrations greater than the permissible exposure limit.

It is often difficult or impossible to measure concentrations of airborne contaminants in real time. Analysis of swipes, scrapings, or breathing zone samples may require up to several days to complete, and they reveal overexposures after the fact. Samples of an atmosphere or surfaces before work begins are generally unreliable indicators of the contamination that could be

introduced as work progresses. Unprotected lead surfaces, for example, readily generate and release lead dust during handling or disturbance. Uncertainties surrounding airborne contamination levels that could be encountered during work dictate highly conservative approaches to specifying respiratory protection equipment.

Industrial standards generally apply to well-defined, day-by-day hazards for which permanent engineering and administrative controls can provide adequate protection for employees. The general intent of a construction standard is to define control measures for transient operations in construction, demolition, dismantling, modification, refurbishment, and similar activities. However, industrial hygienists and work planners should be aware that maintenance, operation, or research tasks that involve employee exposure to lead in general industry frequently meet the criteria of the construction standard.

KEYWORDS: exposure, hazard analysis, industrial hygiene, permissible exposure limit, respirator, work planning

FUNCTIONAL AREAS: Industrial Safety, Work Planning

6. RADIOACTIVE TANK CONTENTS CONTAMINATE STEAM LINE

On August 10, 1999, at the West Valley Vitrification Facility, an operator inadequately performed a procedure for purging level and density probes in a concentrator feed make-up tank and created a radiologically hazardous condition when he opened steam purge valves with little or no steam in the purge line. The liquid in the tank was a high-level waste slurry from fuel reprocessing operations that was being recovered for vitrification. The procedure required the operator to verify the presence of steam in the line before purging the probes. However, he did not adequately perform this verification, and radioactive liquid from the tank flowed into the steam line. When the operator opened the steam valve, the area radiation monitor alarmed. Initial dose measurements on contact with the steam line indicated 12 Rad, with general radiation levels in the plant-operating aisle measuring 350 mrem/hr. Operations personnel restricted access to the affected areas of the vitrification facility, and radiation protection department technicians escorted personnel who required access. Facility operators locked-closed the valves that supply steam to the tank probes. Failure to adequately follow procedure requirements when systems contain or interface with radioactive material can create hazardous situations for personnel and can unnecessarily increase personnel dose rates. (ORPS Report OH-WV-WVNS-VFS-1999-0005)

Investigators determined that the operator was purging the tank probes under a radiological work permit issued for that evolution. They also determined that he checked the procedure that indicates deviations from the base facility valve lineup before opening the valve to initiate steam flow to the probes. Investigators determined that the operator had only seen the evolution performed and had not performed it himself before this event. They discovered that the steam line had been vented, drained, and isolated for over 16 hours before the operator started the steam purge, but the operator did not know this. Investigators believe that a vacuum formed in the steam line as it cooled that was sufficient to lift the radioactive slurry from the tank back into the line when the operator opened the steam purge valve.

Investigators also determined that the procedure for purging the probes required the operator to confirm the presence of steam in the line before initiating the purge. Methods for doing this include: (1) blowing down a steam trap on the line, (2) observing and listening to the operation of the steam trap, (3) observing a pressure gage on the line, and (4) using a pyrometer or thermocouple to ensure the temperature of the steam trap is greater than 93 degrees. Of these methods, the procedure required the operator to measure the steam trap temperature and blow it down. The operator stated that he opened the steam-trap drain valve and saw a puff of steam and a small amount of condensate blow-down from the trap. Investigators determined that instead of measuring the temperature of the line with a pyrometer or thermocouple, the operator only felt the temperature near the steam trap with his hand. They also determined that the

personnel who drained and isolated the steam line on a previous shift did not adequately communicate this information to the personnel performing the steam purge by (1) making a logbook entry, (2) annotating the operating procedure for system configuration, or (3) entering the lines status on the turnover checklist.

Facility managers have determined that the direct cause of this event was the operator inadequately executing an established procedure. They have formed a team to evaluate the event and ensure that appropriate corrective actions are established to prevent recurrence.

They have also implemented the following actions.

- Placed vitrification processing operations on hold pending further investigation.

- Performed an initial flush of the steam supply piping that was successful in reducing the dose rates in many of the affected areas. Operations personnel are planning additional flushes to address the remaining high-dose areas.

NFS has reported other events where inadequately performing procedures or procedure violations have created hazards to personnel. Some examples follow.

- Weekly Summary 99-22 reported that two chemists at the Paducah Gaseous Diffusion Plant were exposed to a methylene chloride vapor concentration that exceeded the OSHA short-term exposure limit. The chemists were extracting soil samples with methylene chloride and acetone. Their process procedures required all work to be performed under a ventilated hood, but the chemists placed some samples outside the hood, which increased their exposure to the methylene chloride and increased their risk of adverse health effects. (ORPS Report ORO--BJC-PGDPENVRES-1999-0003)

- Weekly Summary 98-25 reviewed two events concerning personnel who did not adhere to radiography procedure requirements. In the first event, an operator at the Savannah River Site entered a barricaded area while radiography was being performed because he incorrectly assumed that he was able to pass through the area without an escort. Although the operator did not receive any exposure, the facility manager determined that the potential for injury to the operator was significant. In the second event, researchers at the Los Alamos National Laboratory Pajarito Laboratory failed to make proper notifications, post an exclusion area, or activate warning lights before conducting a radiography experiment, resulting in two security officers receiving a potential unattenuated dose of approximately 1 millirem. Investigators determined that the researchers had failed to follow the procedure for the experiment. (ORPS Reports SR--WSRC-TRIT-1998-0007 and ALO-LA-LANL-TA18-1998-0006)

This event underscores the importance of rigorous attention to detail when following procedures. Proper procedure usage is crucial to ensure the safe operation of facility equipment and systems. Operators should maintain a questioning attitude and stop work when the configuration of a system or process is not as expected. If the operator in this event had correctly verified the temperature of the steam line, a questioning attitude might have prevented him from creating a hazardous radiological condition. Timely communication and turnover of equipment and system status is also necessary to prevent damage to equipment and to prevent creating unnecessary hazards to personnel. If the status of the steam purge line had been communicated to the operating shift performing the purge, this event could have been prevented.

Facility managers should stress proper procedure usage, attention to detail, and the necessity for timely communication of facility status during operator training. They should also review the following documents to ensure that (1) operations personnel understand their responsibilities and (2) management policies exist that reinforce a questioning attitude.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, "Control of Equipment and System Status," states that it is imperative that equipment and systems be properly controlled. Not only must the operating shift be aware of how systems and equipment will function for operational purposes, but to satisfy design bases and operational limits, the proper component, equipment, and system configurations must be established and maintained. Chapter XII, "Operations Turnover," prohibits personnel from assuming operational duties until they and the offgoing shift have a high degree of confidence that an appropriate information transfer has occurred. Shift turnovers should be guided by a checklist and should include a thorough review of appropriate documents describing important aspects of facility status. Equipment operator checklists should note major component status, abnormal lineups, valid alarms on local panels, and surveillances or evolutions planned or in progress.

- DOE/EH-0502, Safety Notice 95-02, *Independent Verification and Self-Checking*, describes a technique that requires workers to (1) stop before performing a task to eliminate distractions and identify the correct component; (2) think about the task, expected response, and actions required if the expected response does not occur; (3) act by reconfirming the correct component and performing the task; and (4) review by comparing the actual versus the expected response.

DOE O 5480.19 is available at http://www.explorer.doe.gov:1776/htmls/currentdir.html. Safety Notice 95-02 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: conduct of operations, configuration management, equipment status, exposure, radioactive waste, tank

FUNCTIONAL AREA: Conduct of Operations, Configuration Control

7. NEAR MISS WHILE USING RESCUE BREATHING APPARATUS

This week, OEAF engineers reviewed an updated occurrence report on a July 28, 1999, incident at the Waste Isolation Pilot Plant (WIPP), where a Waste Isolation Division employee experienced breathing difficulties while strapped down in a stretcher, wearing a Draeger Self-Contained Breathing Apparatus (SCBA). Drill coordinators had designated the employee a "victim" in an annual emergency management drill, so rescuers had strapped him to the stretcher and placed the SCBA on him. When the employee began struggling, a safety observer immediately removed the mask from his face. Medical personnel attended to the employee, who fully recovered and returned to work. Based on a description of the malfunction, investigators concluded that the breathing hose on the SCBA unit had crimped during the exercise. Draeger acknowledged that hoses on these units have a propensity for crimping. Although SCBAs are one of the most important pieces of personal protective equipment used by firefighters and rescue personnel, injury may occur if the unit fails during use. (ORPS Report ALO--WWID-WIPP-1999-0004)

WIPP personnel were conducting a large-scale exercise that involved a simulated underground fire and explosion with several simulated casualties. Drill participants summoned trained mine rescue teams from WIPP and from three local commercial potash mines to the scene. Rescuers found the employee designated to portray a victim with "severe injuries" requiring evacuation.

Rescuers strapped the victim to a Stokes stretcher and, because of simulated smoke, placed a Draeger model BG4AP SCBA on him. Within moments, the employee experienced difficulty breathing. Because he was strapped to the stretcher, he could not remove the facemask until a safety observer helped him. Drill coordinators immediately terminated the exercise. They also summoned medical personnel to assist the employee because he had difficulty establishing a normal breathing pattern.

An investigation team performed a root cause analysis of the event and developed corrective actions. The SCBA unit involved in the incident belonged to a team from one of the local potash mines. They did not participate in the investigation and did not make the unit available for examination. Therefore, investigators could only assume that the most probable cause was a crimped breathing hose. They believe the hose crimped while rescuers moved the stretcher. The SCBA manufacturer (Draeger) has recognized the potential for these corrugated breathing hoses to crimp under certain conditions. They offer a retrofit kit (part number R34316), which is essentially a sleeve that protects the hose and minimizes the possibility of crimping. Waste Isolation Division personnel are procuring several of these kits for SCBA units at the WIPP facility. WIPP mine rescue teams have long used Draeger model 174A units on stretchers specifically because their hose configuration makes crimping less likely. They have also developed a simple bracket for the model 174A so that it rides on the stretcher in a position that virtually prevents a crimped hose. They strongly recommend that organizations using model BG4AP or BG4CP units consider installing the upgrade kit.

Investigators discovered that another incident with a Draeger SCBA unit occurred during the drill. Another employee, (also portraying a victim and strapped down into a stretcher) had a malfunctioning SCBA that operated and failed intermittently. A member of the rescue team that supplied the unit stayed with the victim and opened a bypass valve on the unit every time the SCBA failed. This failed unit also belonged to the team from the potash mine that did not make their units available for inspection. However, a WIPP mine rescue safety equipment specialist with thorough knowledge of this equipment was already aware of a design problem that allows misalignment between the minimum valve bayonet mount and the breathing bag. He demonstrated this problem to the investigation team and showed that the misalignment results in the unit operating intermittently. Investigators determined that this is the most probable root cause. They plan no corrective actions regarding this second incident because (1) WIPP rescue team personnel have previously been trained on proper assembly of the SCBA units, and (2) breathing bags and minimum valve assemblies on these SCBAs are marked to assist with proper alignment.

Investigators also determined that a significant cause of this event was an inadequate appreciation for the potential of placing personnel at risk during drills involving the actual use of SCBAs. When personnel are immobilized in a stretcher and a respirator is placed on their face, they are helpless and entirely dependent on the vigilance of others for their safety. As was seen in this event, the last remaining barrier (a safety observer) prevented a significant injury to the employee. WIPP safety personnel will revise drill and exercise procedures to include specific prohibition against placing respiratory devices on the face of simulated victims.

This event illustrates that breathing apparatus must be properly maintained and used in a manner that prevents failures. It is also essential that users are familiar with the operation of the equipment. Safety personnel should verify that the breathing apparatus is operable before it is used in drills and training exercises. This is especially important when using equipment from an outside source, when maintenance and care of the equipment cannot be controlled or verified. SCBAs should be tested and certified in accordance with the requirements of National Fire Protection Association (NFPA) 1981 (1992 and 1997 Editions), *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*.

United States Fire Administration Technical Report 0088, "*Prevention of Self-Contained Breathing Apparatus Failures*," states that catastrophic failures of SCBA are very rare, but that low-order failures (improperly connected regulators, improperly connected or tightened hoses, inadequate face-to-faceplate seal resulting in air leakage, or blown O-rings during cylinder changes) are more common. The technical report is available at http://www.usfa.fema.gov/usfa/techreps/tr088.htm.

KEYWORDS: emergency drill, industrial safety, self-contained breathing apparatus

FUNCTIONAL AREAS: Emergency Planning, Fire Protection, Industrial Safety

8. UNDERGROUND UTILITY GOOD PRACTICE CONFIRMED

On August 25, 1999, at the Paducah Gaseous Diffusion Plant, a subcontractor trackhoe operator performing excavation activities struck a warning tape buried four to six inches underground. The tape marked the presence of a telecommunications line buried beneath it. The operator stopped work, and the subcontractor technical representative suspended excavation in the immediate area of the buried line. Facility managers had issued an excavation/penetration permit to the subcontractor that showed the line buried in the planned work area. Investigators determined that the permit required the subcontractor to use the services of a state underground utility locator service before beginning work. The operator did not use the underground utility locator service as required, but the marking tape warned him that an underground utility existed in the work area before he could accidentally sever the telecommunications line. (ORPS Report ORO--BJC-PGDPENVRES-1999-0013)

Weekly Summary 99-33 reported that subcontractor workers using a powered posthole digger struck and breached a 2-inch polyvinyl chloride groundwater transfer line. The workers excavated the line with hand tools and discovered an energized 480-V line running in the same trench. (ORPS REPORT ORO--BJC-K25GENLAN-1999-0013) That article emphasized a good practice that helps identify underground utilities by burying a colored ribbon or tape an appropriate distance above the lines to mark their location. If the underground utility is non-conductive (*e.g.*, polyvinyl chloride piping), the warning tape should also be conductive. The existence and exact location of buried utilities can then be verified in the field using an appropriate combination of radar, magnetic, and sonic detectors. Excavation in the area will expose the warning tape before penetrating an identified or unidentified underground utility.

Environment, Safety, and Health personnel at Paducah use a graded approach for protecting underground utilities that depends upon the safety significance and hazard associated with the utility being buried. Some of their methods include (1) encasing critical electric circuits in red-dyed concrete, (2) placing boards and marking tape above lines, and (3) back-filling trenches holding utilities with dyed soil. For more information about the graded approach and methods used at Paducah, contact Michael D. Baker, safety advocate, at (270) 441-5227 or e-mail at b8k@ornl.gov.

KEYWORDS: good practice, excavation, industrial safety, underground, utility

FUNCTIONAL AREAS: Construction, Industrial Safety

FINAL REPORT

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. SUBCONTRACTOR EMPLOYEE RECEIVED ELECTRICAL SHOCK

On June 14, 1999, at the Strategic Petroleum Reserves Big Hill Site, a subcontractor laborer looking for a cable identification tag inside a power distribution center panel inadvertently touched her head on two 480-V bus bars and received a severe electrical shock. She was unable to free herself from the electrical source, so an electrical helper kicked her hip until she was dislodged. A nearby field operator and a pipe foreman saw the event and immediately notified the operations control center to initiate an emergency electrical shut-off to the building and notify the site emergency response team. Emergency help air-lifted the laborer to an area hospital, where she was treated for third-degree burns. Investigators determined that neither a safe work permit nor a lockout/tagout was issued for this work and the laborer was not adequately trained to perform work near energized equipment. (ORPS Report HQ--SPR-BH-1999-0004)

Three subcontractor workers (an electrical journeyman, an electrical helper, and a laborer) were preparing previously run electrical cables for upcoming testing and termination by removing electrical insulation from wire conductors. The journeyman removed the covers from two distribution panels to locate the cables and remove the insulation while his co-workers removed insulation from previously run wiring in nearby, de-energized panels. The journeyman noticed that the panels he opened were energized, but he did not tell his co-workers and did not perform a lockout/tagout. The journeyman removed the insulation, closed the panel covers, and prepared to leave the area. As he was leaving, the electrical helper told him that he believed that there was still one cable in the panel the journeyman had worked on that needed to have insulation removed. The two briefly discussed the remaining cable-stripping task, and the journeyman left the area, leaving the helper and the laborer to finish the task. The electrical helper removed the cover of the energized power distribution panel, located the remaining cable, and began removing the insulation. He noticed that the identification tag was missing from the cable and asked the laborer to look inside the open panel cover and search for the tag. While looking for the identification tag, the helper inadvertently made contact with the energized 480-V bus bars. Figure 1-1 shows the electrical distribution panel. Figure 1-2 shows the 480-V bus bars.

Figure 1-1. Electrical Distribution Panel

Figure 1-2. Bus Bars

Investigators determined that a construction management field representative, an electrical foreman, and a site safety specialist entered the area while the subcontractor employees were working. None of them ensured that workers were wearing appropriate personnel protective equipment or were performing the work under an approved lockout. Investigators identified the following causes for this event.

- The subcontractor general electrical foreman failed to (1) provide a job plan for the work, (2) conduct an inspection of the work area, (3) assign a supervisor to the electrical helper and the laborer, and (4) provide an adequate pre-job brief.

- Electrical supervisors believed that a safe work permit and lockout log that were issued for associated work in the same area also applied to the cable insulation removal. However, no one reviewed the work permit requirements with the applicable electrical supervisors or employees, violating site safety task planning requirements.

- Subcontractor personnel did not (1) adequately train employees on lockout/tagout procedures, (2) assign trained personnel to the job, (3) provide adequate supervision to untrained personnel, and (4) perform an adequate turnover from associated work.

- Subcontractor personnel did not enforce the lockout/tagout requirements as required by the safe work permit, and the contractor safety electrical plan and did not enforce personnel protective equipment requirements in accordance with the safe work permit and site personnel protective equipment hazards assessment.

- Subcontractor personnel did not ensure that the corrective action plan for a previous event was implemented. The corrective actions required workers to test electrical cables to determine the presence of hazardous energy.

NFS has reported similar electrical events in the Weekly Summary. Some examples follow.

- Weekly Summary 99-10 reported that an operator at the Hanford Waste Encapsulation and Storage Facility received an electrical shock while removing a sticker from the inside of an electrical panel. He was shocked when he touched the contacts of an energized, 120-V indicator light. The operator was not qualified to work near exposed, energized circuits and could have been seriously injured. (ORPS Report RL--PHMC-WESF-1999-0005)

- Weekly Summaries 98-23 and 97-44 reported that two subcontractor electrical workers at Fermi National Accelerator Laboratory received flash burns from an electrical arc blast when a metal cover contacted an energized bus bar as they attempted to connect a neutral cable for a temporary feed from a 480-V motor control center panel. A Type B Accident Investigation Team identified the following root causes for the event: (1) the electricians did not understand that there were energized components behind the bus bar cover, and (2) the Laboratory failed to ensure that an integrated safety management system was implemented for electrical work. (*Type B Accident Investigation Board Report on the October 22, 1997, Electrical Arc Blast at Building F-Zero, Fermi National Accelerator Laboratory, Batavia, Illinois*, November 1997; and ORPS Report CH-BA-FNAL-FERMILAB-1997-000 4)

In the Big Hill Site event, work controls, documentation, and communication for electrical work were inadequate to satisfy the five core functions of DOE's Integrated Safety Management System: (1) define the scope of work, (2) identify and analyze the work hazards, (3) develop and implement hazard controls, (4) perform work within controls, and (5) provide feedback on the adequacy of controls and on continuous improvement in defining and planning work. A relaxed safety attitude led to work and safety measures that were not clearly defined and a job mission

that was not translated into safe work practices. In addition, safety expectations were not set, and appropriately trained and experienced personnel were not assigned to perform the work.

These events underscore the importance of an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analyses must be included in the work control process to help prevent worker injury. The hazard analysis process should include provisions for lockout/tagouts, job-specific walk-downs, integration of work activities, and personal protective equipment. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with electrical activities.

Personnel at DOE facilities should have a continually questioning attitude toward safety issues. Each individual is ultimately responsible for complying with rules to ensure personal safety. Facility managers should communicate the idea that safety is of prime importance and that all personnel must be committed to excellence and professionalism.

Facility managers, work planners, and crafts personnel should review the following references, which provide guidance and good practices for planning electrical work.

- DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events.

- 29 CFR 1910.333, *Selection and Use of Work Practices*, states: “When any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged out.” It also states: “Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized.” It also requires a qualified person to test the equipment to verify that all circuit elements and equipment parts are de-energized.

- 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* provide guidance on the implementation of effective lockout/tagout programs. They both state that the primary purpose of a lockout/tagout program is to protect personnel from injury and protect equipment from damage. 29 CFR 1910, subpart S, "Electrical," describes work practices to be used to prevent injuries when work is performed near or on equipment or circuits that are, or may be, energized.

- DOE/ID-10600, *Electrical Safety Guidelines*, prescribes electrical safety standards for DOE field offices and facilities. It includes information on training and qualifications, work practices, protective equipment, insulated tools, and recognition of electrical hazards. Section 2.13.1.3 states that when circuits and equipment are worked on they must be disconnected from all electrical energy sources. These guidelines are intended to protect personnel from electrical shock and potential fatalities.

- DOE-HDBK-1092-98, *Electrical Safety*, contains explanatory material in support of OSHA regulations and nationally recognized electrical safety-related standards.

NFS encourages managers to incorporate lessons learned from other organizations and to take these lessons into account in their programs. Managers, supervisors, and operators should review operating experience information and implement it as the standard suggests. Lessons learned are valuable only if the information they communicate is used.

- DOE-STD-7501-95, *Development of DOE Lessons Learned Programs*, was designed to promote consistency and compatibility across programs. Both lessons learned and program managers should review the standard and incorporate applicable elements into their site programs.

- DOE-STD-1010-92, *Guide to Good Practices for Incorporating Operating Experiences*, states: "The use of experience gained should provide a positive method that a facility can use to improve their operations, making them efficient, cost-effective, and safe to the employees, the public, and the environment."

Integrated Safety Management information can be found at http://tis-nt.eh.doe.gov/ism. DOE technical standards can be found at http://www.doe.gov/html/techstds/ standard/standard.html.

KEYWORDS: electrical safety, hazard analysis, near-miss, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Hazards and Barrier Analysis, Work Planning, Industrial Safety

2. SURVEYOR INJURED DURING FALL DOWN AN IRREGULAR SLOPE

On May 23, 1999, at the Weldon Spring Site, a surveyor lost his footing and fell down a slope while performing a topographical survey on the inside slope of a raffinate pit. The surveyor fell approximately six feet onto a vertical cut in the surface, then continued rolling to the bottom of the slope. After falling, the surveyor experienced some discomfort in his right shoulder and hip. On May 25, a medical specialist determined that the surveyor had a torn rotator cuff, requiring outpatient surgery. The fall occurred as he was walking on a localized, excessively sloped surface in the pit. Localized excavations in an otherwise well-graded slope created a hazard and contributed to the surveyor falling and receiving injuries. (ORPS Report ORO--MK-WSSRAP-1999-0014)

Direct-hire organization safety personnel and construction engineers held incident review meetings on May 24 and 26. Attendees developed immediate corrective actions that included a temporary restriction on walking on sloped surfaces in the pit. They determined that the surveyor had been walking on an acceptable slope of 1.5 (horizontal) to 1 (vertical), overall. They also determined that the pit had areas of localized irregularities in the sloped surface where an excavator had scooped out some areas to remove radiological "hot spots." The pit had at least three localized excavations, one of which was approximately six feet deep.

The facility manager attributed the occurrence to the following causes.

Direct Cause: Design Problem/Inadequate Work Environment — The raffinate pit contained localized areas where the slope was unsafe for workers.

Root Cause: Personnel Error/Communication Problem — Direct-hire organization safety personnel recognized safety concerns regarding excavations with slopes greater than 1.5 to 1. However, they did not adequately communicate these concerns to their counterparts in the organization responsible for excavating the localized "hot spots" in the pit.

The facility manager identified corrective actions that included (1) training personnel on hazards associated with excavations, (2) ensuring that slopes are not steeper than 1.5 to 1 before allowing employees to walk on them, and (3) requiring personnel to contact the direct hire organization safety office before walking on sloped excavations.

The following references provide guidelines for excavating, working on or near excavated surfaces, and worker safety.

29 CFR 1926, subpart P, *Excavations,* applies to all open excavations made in the earth's surface. The subpart states that all surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees. The regulation specifies sloping requirements for excavations, which vary with differences in factors such as soil type and exposure to environmental conditions.

OSHA Standard 2226, 1995 (Revised), *Excavations,* requires that a competent person inspect excavations and the adjacent areas on a daily basis for possible cave-ins, failures of protective systems and equipment, hazardous atmospheres, or other hazardous conditions. Inspections are also required after natural or man-made events that may increase the potential for hazards. The standard states that one method of ensuring the safety and health of workers in an excavation is to maintain the slope no steeper that 1.5 to 1 because a slope of this gradation or less is safe for any type of soil.

DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, attachment 2, "Contractors Requirements Document," requires contractors to identify existing and potential workplace hazards and evaluate the risk of associated worker injury or illness. The attachment also requires contractors to implement a hazard prevention/abatement process to manage all identified hazards. Hazard control methods are hierarchized as (1) engineering controls, (2) work practices and administrative controls, and (3) personal protective equipment. Under the standard, the employer must provide safe access and egress to all excavations. The standard is available at http://www.osha-slc.gov/Publications/Osha2226.pdf.

KEY WORDS: excavation, fall, injury

FUNCTIONAL AREAS: Construction, Industrial Safety

OEAF FOLLOWUP ACTIVITIES

1. CORRECTION TO WEEKLY SUMMARY 99-33, FINAL REPORT ARTICLE 1

In Weekly Summary 99-33, the article titled "Radiological Training and Qualification Deficiencies Identified" contained an incorrect reference to the version and title of a DOE Order. The correct version and title is DOE O 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities.* The chapters and sections of the Order cited in the article are correct. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0049)

2. OPERATING EXPERIENCE WEEKLY SUMMARY NOW AVAILABLE VIA E-MAIL

The Office of Nuclear and Facility Safety is now able to send a .pdf version of the OEWS directly to you via e-mail. Here are just a few benefits you will see when you have an electronic copy sent "straight to your desktop."

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